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Several laser systems were acquired using the funds under the AFOSR Research Instrumentation Program. The following laser systems were purchased:

1. 20-W continuous-wave mode-locked Antares Nd:YAG laser from Coherent.

2. Cr:forsterite regenerative amplifier, pulse stretcher, and pulse compressor were custom built by Excel/Quantronix. The regenerative amplifier is pumped by a Excel/Quantronix 20-W 1-kHz Q-switched Nd:YAG laser.

3. Four high-brightness 1-W 970-nm Spectra Diode Laser semiconductor diode lasers.

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DEVELOPMENT OF 1 - 2 μm TUNABLE SOLID-STATE LASERS BASED ON Cr^{4+} AS A LASING ION

RESEARCH INSTRUMENTATION

Air Force Office of Scientific Research

Contract/Grant Number: F49620-93-1-0595

FINAL REPORT

Several laser systems were acquired using the funds under the AFOSR Research Instrumentation Program. The following laser systems were purchased:

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3. Four high-brightness 1-W 970-nm Spectra Diode Laser semiconductor diode lasers.

Laser systems acquired under the Research Instrumentation Program were used (and will be used in the future) to build novel types of tunable solid-state laser systems for the 1130 - 1600 nm spectral region. The laser systems under construction are using Cr:forsterite and Cr:YAG laser crystals.

The major task in the development of chromium-doped forsterite lasers was generation and amplification of femtosecond pulses in the 1200 - 1300 nm spectral range.

The 970-nm semiconductor diode lasers will be used for diode-pumping of the Cr:forsterite laser.

1. Generation and Amplification of Tunable Femtosecond Pulses

Continuous-wave mode-locked femtosecond Cr:forsterite oscillator and multikilohertz repetition-rate regenerative amplifier for generation and amplification of of tunable fs pulses were built. Standard 4-mirror astigmatically compensated laser cavity was constructed. The 20-W continuous-wave mode-locked Antares Nd:YAG laser from Coherent acquired using the funds under the AFOSR Research Instrumentation Program is being used to pump the Cr:forsterite femtosecond oscillator. The experimental setup is presented in Fig. 1.

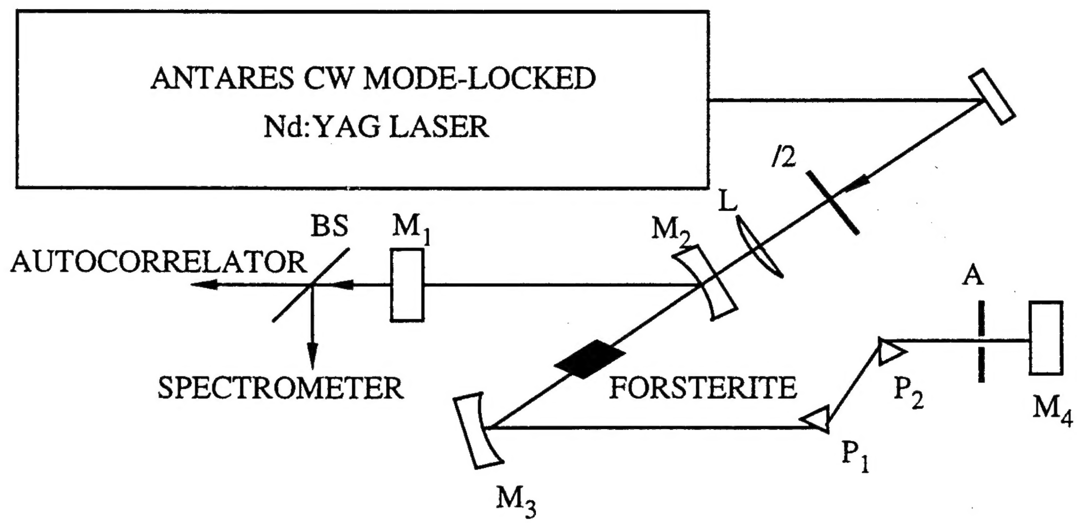

Figure 1. The femtosecond self-mode-locked Cr:forsterite laser with the ANTARES Nd:YAG mode-locked pump laser

The femtosecond pulses produced by forsterite oscillator are amplified using a regenerative amplifier. Regenerative amplification is based on multiple passes of a weak pulse through an inverted (pumped) gain medium. Once the gain is saturated, the amplified pulse is switched (dumped) out of the resonator cavity. Gains of several orders of magnitude can be achieved.

The Cr:forsterite regenerative amplifier, pulse stretcher, pulse compressor, and a Q-switched kHz Nd:YAG pump laser were custom built by Quantronix using the funds under the AFOSR Research Instrumentation Program. A schematic of the Cr:forsterite regenerative amplifier pumped by a Quantronix kHz Q-switched Nd:YAG laser is presented in Fig. 2.

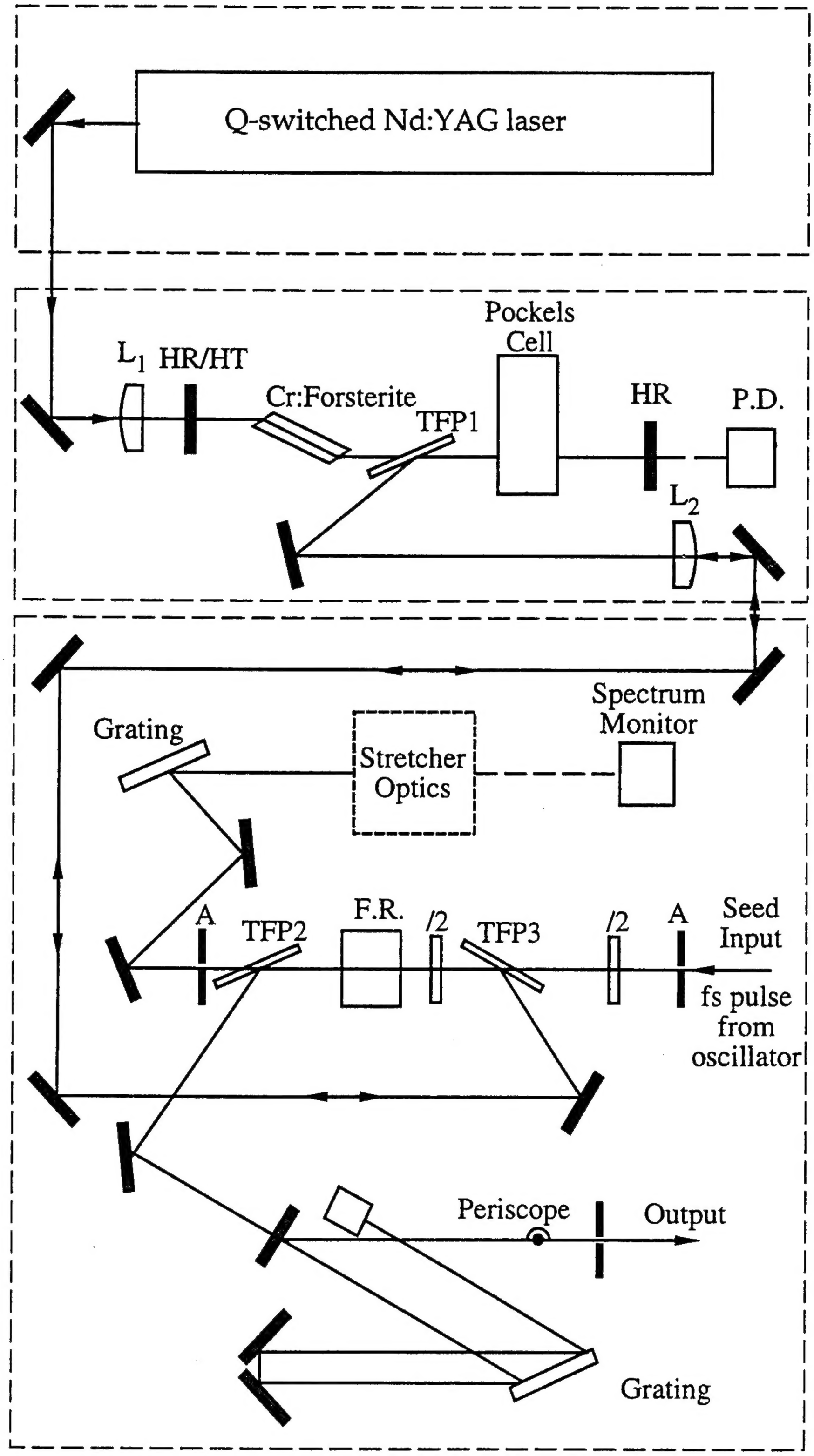

Figure 2. Cr:forsterite regenerative amplifier pumped by a Quantronix kHz Q-switched Nd:YAG laser. (TFP=Thin Film Polarizer, A=Aperture, FR=Faraday Rotator, PD=Photodetector)

2. Semiconductor Diode Pumped Solid-State Lasers

The diode-laser-pumped Cr:forsterite systems under development are shown schematically in Fig. 3. Two proposed cavity designs will be investigated: The three mirror resonator described in Figure 3 (a) requires anti-reflection and high reflection coating at the laser wavelength to be applied to either end of the Cr:forsterite crystal as well as an anti-reflection coating at the pump wavelength on the pump laser side of the crystal. This geometry allows two laser diodes to be used to pump the active medium. By using a four mirror resonator (detailed in Figure 3 (b)) the number of diodes utilized, and hence the pump power available is doubled. Four 1-W, 970-nm SDL 6360-C diode lasers and two 2-A drivers (SDL 800 M) were purchsed from Spectra-Diode Lasers using the funds under the AFOSR Research Instrumentation Program for this purpose.

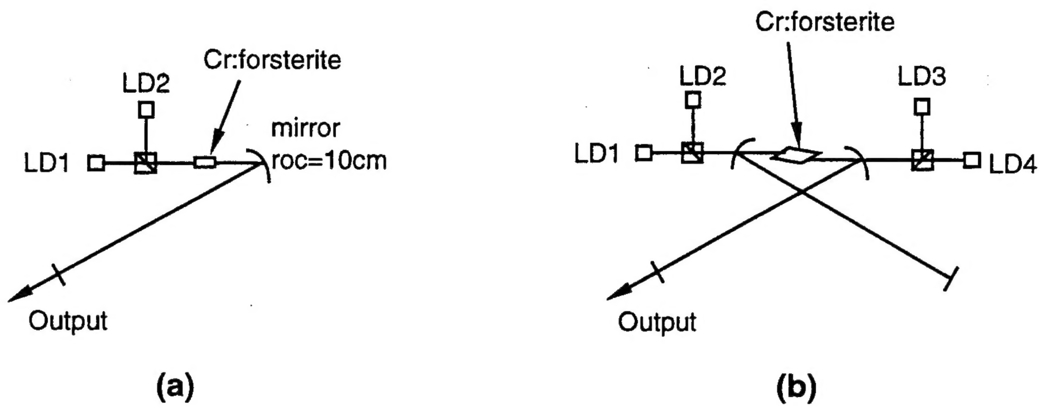

Figure 3. (a) Three mirror resonator and (b) four mirror resonator suitable for diode pumping investigations. LD1, LD2, LD3, and LD4 are 1-W, 970-nm SDL 6360-C diode lasers.

3. Gain-Switched Cr^{4+}:YAG Laser

The 1-kHz repetition rate continuosly-pumped Q-switched Nd:YAG laser purchased under the AFOSR Research Instrumentation Program and previously mentioned in Fig. 2 was also used to pump a Cr^{4+}:YAG laser to generate over 150 mW 1-kHz tunable near-infrared laser pulses in the eye-safe 1.4 - 1.5 μm spectral region. The 1-kHz, Nd:YAG pumped Cr^{4+}:YAG laser is shown in Fig. 4.

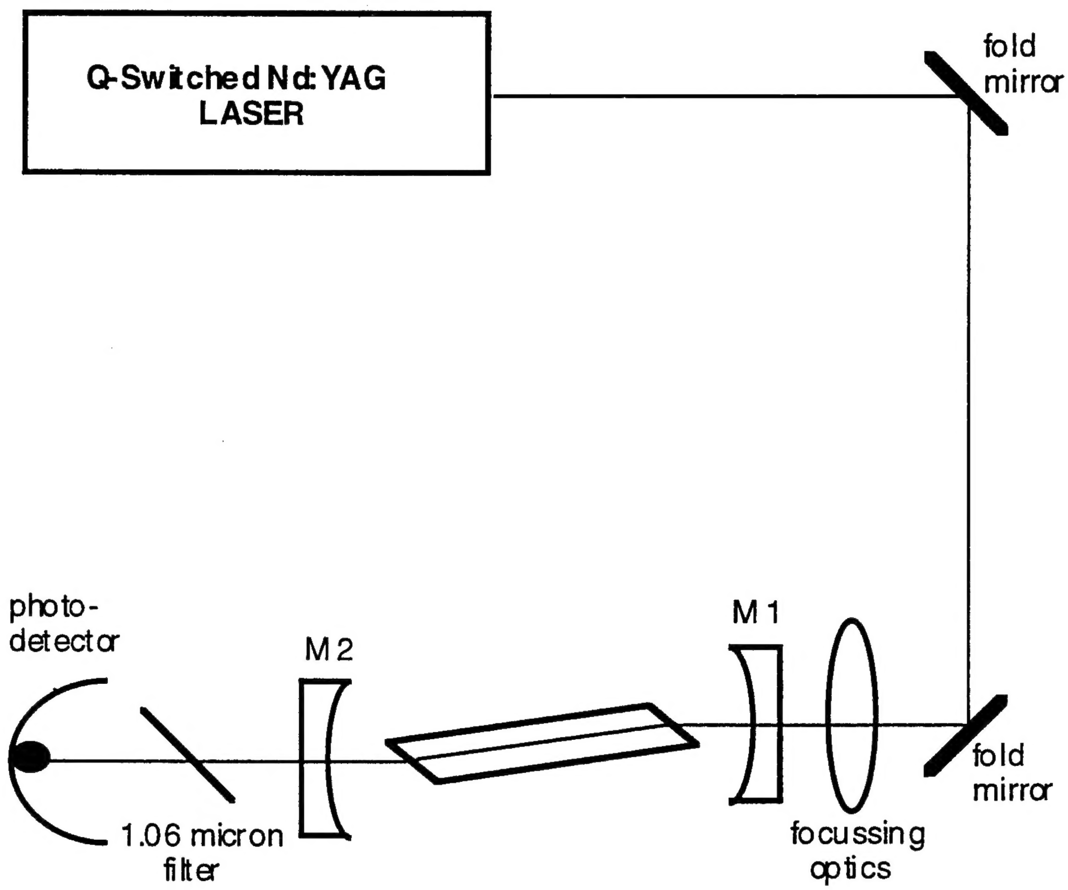

Fig. 4. 1-kHz, Nd:YAG pumped Cr^{4+}:YAG laser .